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BRIEFER ARTICLES

AN ATMOMETER

(WITH FOUR FIGURES)

The introduction of the porous cup atmometer by LIVINGSTON has been followed by great activity in securing evaporation data in relation to plant life. Readings have usually been made with reference to a zero point, usually a file-scratch, on the wall of the reservoir containing the water. For most workers it has been impossible to visit the field more frequently than once a week. The records secured were of course simply the total weekly evaporation.

It is becoming increasingly clear that the record of total weekly evaporation can be evaluated only when we know the rate of evaporation at all times, and particularly when we know the maximum and minimum rate. This need can be met only by some form of automatic measuring and recording device. No such instrument has yet come into general use. To meet the conditions of the work such an instrument must measure in convenient units and record in graphic form. It must be so simple that it may be set up easily in the field and trusted to work with only occasional attention. Also the cost of construction must not be so great as to prohibit the employment of a sufficient number of them to secure comparative data. In attempting to meet these conditions as I have found them in the field, the instrument described herewith has been designed (fig. 1).

The device (fig. 2) consists essentially of an oscillating beam (*A*), which may be caused to tilt by the movement of mercury in a tube (*B*) and its connected bulbs, advantage being taken of the oscillation to open the stopcock (*C*) and to close it again. At the same time an electric circuit is closed which actuates the pen of the chronograph.

In practice the whole apparatus is filled with water and the stopcock closed. Mercury is poured into the bulb *b'*, nearly filling it, the inlet *e'* is connected with the supply tank of water, and the outlet at *d'* with the atmometer. The water which evaporates from the atmometer is replaced by a flow through the pipes *d*, *c*, and *a* from the supply in the bulb *b'*. The mercury in *b* follows the water, partially filling *b'*.

Whenever the transfer of weight from *b* to *b'* has gone far enough to shift the center of gravity to the right of the center of suspension

(*F*), the beam *A* is caused to revolve until checked by the stop *g'*. As the end of *A* moves upward it carries with it the flange *f*, which strikes the

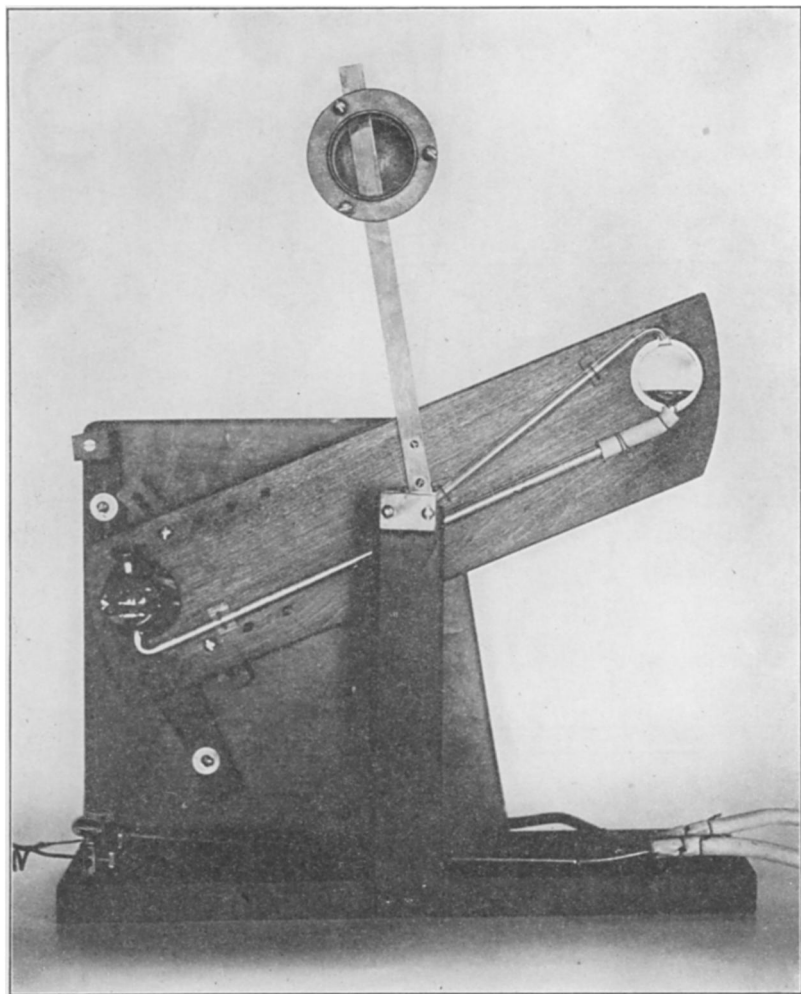


FIG. 1

handle of the stopcock and pushes it upward, thus opening the passage from the water supply through *e*, *c*, and *a* into *b'*. The stop *g'* is so located that *b* does not rise to quite so high a level as *b'*, and the mercury

therefore flows back toward *b*, followed by the water which again fills *b'*. The shifting of weight toward the left causes *A* to return to its

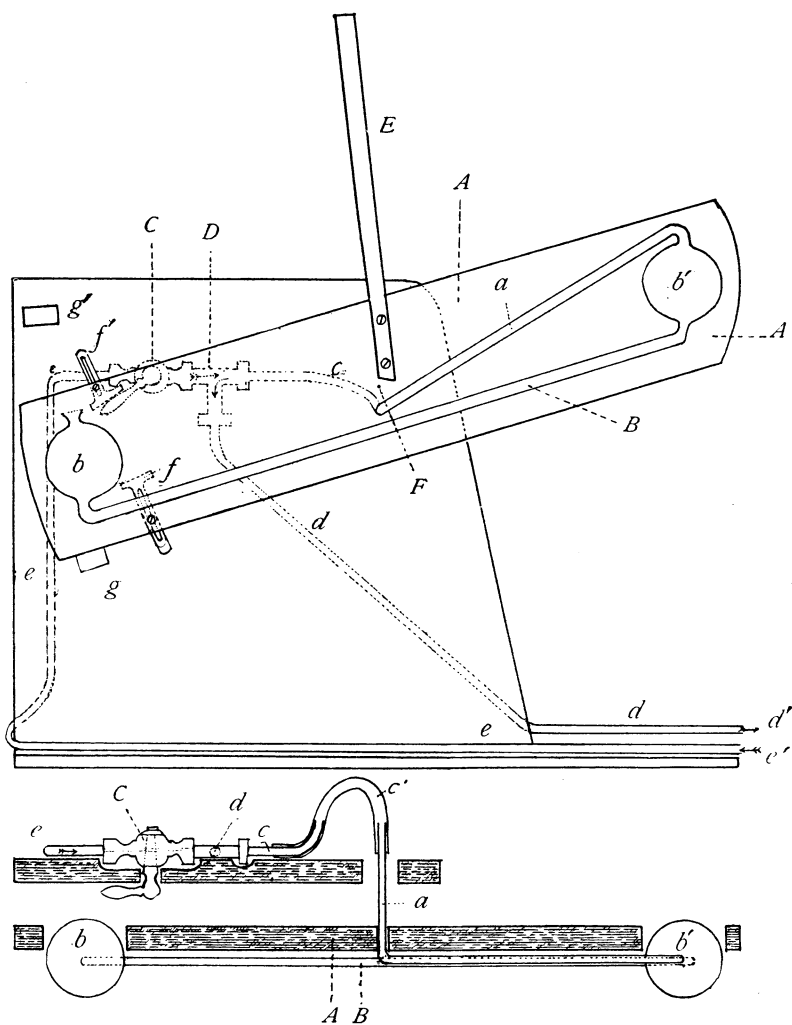


FIG. 2

former position, the flange *f'* in its downward movement closing the stopcock *C*.

The point of suspension (*F*) is placed lower than the center of gravity

of the whole system consisting of *A* and its attached parts. In the initial position, as shown in the figures, the center of gravity is not only higher than *F*, but also at some distance to the left of a perpendicular through *F*. A considerable amount of mercury must therefore pass into *b'* before the center of gravity will have shifted to the right of the perpendicular sufficiently to tilt the beam. The tilting of the beam carries the center of gravity yet farther to the right, and the beam therefore rests in the new position until the reverse movement of the mercury has carried the center of gravity to its former position in the beam. It is evident that if the center of gravity be raised yet higher above *F*, it will also be farther to the left when in the first position, and a larger volume

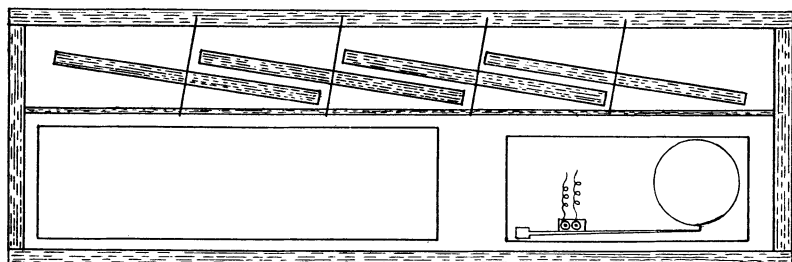


FIG. 3

of water will have to be displaced from *b'* by mercury before the beam will tilt. Each record, therefore, will indicate a larger amount of water.

Advantage is taken of the relation between the center of gravity and the center of suspension to calibrate the instrument. A weight is placed upon the bar *E*, and by sliding it up or down the bar or exchanging it for another, the center of gravity is adjusted at will. The point of suspension may also be moved.

The atmograph, set up as shown in the photograph (fig. 4), recorded the passage of 10 cc. units. By lowering the weight, the quantity could be reduced by half, or set at any intervening amount. Experience indicates that under ordinary conditions 10 cc. will be a convenient unit for field work with LIVINGSTON atmometers.

Standard copper pipe and fittings are used throughout, no rubber being employed excepting for the flexible connection *c'*. Electrical connections are made from one of the binding posts shown in the photograph to the pipe *e*, and from the other to the flange *f*. The circuit is closed through the stopcock while *f* is in contact with the handle. A single dry cell is employed as the source of current.

The atmograph may be employed in the measurement of the transpiration of an excised branch by tying the branch into a rubber tube and connecting with the outlet at d' , or it may be used in other cases in which it is desired to measure the passage of water.

For observation in the field the instrument must be inclosed in a box in order to preserve it from interference. If it is desirable to operate several atmometers at a single station, as described by YAPP, the atmographs may be compactly arranged in a box with a common reservoir

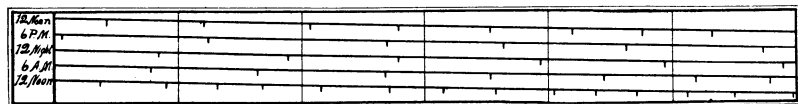


FIG. 4

and a single chronograph (fig. 3), as many pens being used as atmographs. Experience has shown that the piping leading to the atmometers should be metallic. Glass and rubber are subject to many hazards, not only from vandals but also from the less conspicuous members of the fauna. Grasshoppers sometimes exhibit a very interesting, but none the less disastrous, adaptation of appetite to the supply of rubber tubing.

For a series of simultaneous records a chronograph drum rotating in seven days will be found desirable. The records shown in fig. 4 were made in the laboratory upon a chronograph rotating once in six hours and with a group of four LIVINGSTON atmometers. The interval required for the evaporation of 10 cc. by the four cups has been noted to vary, within twelve hours, from a maximum of 113 minutes to a minimum of 17 minutes.—W. L. EIKENBERRY, *The University of Chicago*.

THE SPORANGIUM OF LYCOPODIUM PITHYOIDES

(WITH PLATE VII)

So much importance has been attached at various times to the position, shape, and development of the sporangium in *Lycopodium*, that any unusual forms are of interest. The rare species *L. pithyoides* Schlect and Cham., which is figured in a former paper,¹ presents certain variations. The stem tip is large and blunt, with a flattened apical region. The earliest stages in the development of the sporangium agree with those of previously

¹ STOKEY, A. G., The roots of *Lycopodium pithyoides*. BOT. GAZETTE 44:57-63. 1907.